DESCRIPTIONS OF NEW SPECIES OF *LEAIA*.

By John Mitchell, late Principal of the Technical College and
School of Mines, Newcastle, N.S.W.

(Plates xli-xliii.)

[Read 25th November, 1925.]

Introduction.

The history of the genus *Leaia*, as far as Australia is concerned, is a brief one. The first Australian specimens of the genus were found by the writer (1890) in some fragments of chert rock, used to macadamize the main road between Belmont and Charlestown, and hence were not *in situ*. These specimens were handed to the late R. Etheridge, Jr., for identification, and later were described by him (Proc. Linn. Soc. N.S.W., (2) vii, 1892) under the name of *Leaia mitchelli*. Subsequently, from a load of the same kind of material referred to above, placed by the roadside at Belmont, Lake Macquarie, for conversion into road metal, the writer had the good luck to discover a number of beautifully preserved fossil insect wings (1898), which proved, and are still proving to possess special scientific value. After much search, the quarries yielding the rocks containing the phyllopods and insect remains were located, and since then many additional fossil examples of *Leaia* and insects have been gathered, among which quite a number of new types occur.

As will appear from the contents of this paper, new species, or varieties, as the case may be, of *Leaia*, found since the publication of the late Mr. Etheridge's paper descriptive of the first species of that genus from Australia, prove to be so numerous as to make it advisable to extend the history of the genus.

An outstanding feature in connection with *Leaia* in the Newcastle Coal Measures, is the relatively large number of species or varieties found together in the Belmont Beds in a stratum not more than half an inch in thickness. From this layer have been obtained several forms more or less resembling *L. leidyi* Lea, and *L. mitchelli* Eth. Junr., several tricarinate species, one quadricarinate, one unicarinate (?), and a discoidal form; and further, it is to be noted that odd examples are met with in these measures throughout a thickness of some six hundred feet, from the Dirty Coal Seam up to the Belmont Beds; and throughout this same range also, fossil insect remains are in evidence as well as *Estheria* in considerable variety; these latter it is intended to describe later.

The fossil flora and fauna associated with the *Leaia* now under discussion go to show that they were dwellers in fresh, quiet, and shallow water; and their end, in the Belmont Beds, was brought about by the sudden drying up of the waters, aided by an invasion over the area of much volcanic dust. This would account for the large number of fossil *Leaia* now found in the thin layer of rock in the Belmont quarries referred to above. It may be pointed out here that the so-called chert rock of the Belmont quarries, which is met with also in thin beds at different horizons in the Newcastle Coal Measures, has been declared by Mr. Card, Curator and Mineralogist, Geological and Mining Museum, Sydney, to be composed of volcanic dust, and his view has had general acceptance; hence these rocks are tuffs.

In the Newcastle Coal Measures, from beds some eight hundred feet or more below the Belmont Beds, and over three hundred feet lower in the series than the Dirty Coal Seam (the lowest horizon from which *Leaia* has been obtained), specimens of a beautifully preserved fish (*Elonichthys davidi*) were collected. This genus is very characteristic of later Palaeozoic rocks in Europe and North America (A. Smith Woodward, *Mem. Geol. Surv. N.S.W.*, 1908); but the *Elonichthys semilineatus* described by A. Smith Woodward (*loc. cit.*) from the brick clay-pits of St. Peters, Sydney, is of Mesozoic age, and therefore the occurrence of *Elonichthys* in the Newcastle measures affords no definite evidence of their age.

The classification of *Leaia* in the present paper has been to the writer a somewhat difficult task, and he admits exception may be taken by some to the manner in which the classification has been completed; he has followed the example set by the late T. Rupert Jones in his Monograph of the Fossil Estheriae (*Mem. Pal. Soc.*, 1862), where he separated the individuals of the genus *Leaia* dealt with by him, from one another, varietally at least, on very small differences.

A feature quickly noticed in *Leaia* from the Belmont Beds is their flatness. This probably arises from the delicacy of the shells, and the rapid deposition of sediment immediately they had been overtaken by disaster.

The late Mr. Etheridge, when describing the first species of *Leaia* found in these measures, did not discuss its value from a stratigraphical point of view. This is remarkable, as the writer is of opinion that no other fossil obtained from these measures indicates so distinctly the palaeozoic age of the rocks; he considers that neither the abundant fossil flora nor the remarkable and varied insects from these measures show conclusively whether they are of Permian or Lower Triassic age. *Leaia*, however, has never been found in rocks younger than Permian, and its presence in considerable abundance in the Newcastle Coal-measures seems reasonable proof that these rocks are not newer than Permian.

Another point worthy of notice in connection with these Belmont Beds is the distinct evidence they afford of the waning of the *Glossopteris* and *Phyllotheca* types of flora. Fragments even of the latter genus are rarely met with, while several species of the former genus which occur abundantly in strata belonging to the Dirty Coal Seam horizon, are here not in evidence. Among these may be enumerated *Glossopteris Browniana* (the true type), *G. ampla*, *G. arachnoides*, etc. *G. linearis* still persists, and is here the commonest species met with, as are also those exceptionally long persistent genera *Gangamopteris* and *Noeggerathiopsis*, and more than one new form of *Glossopteris* makes its appearance here, seemingly, for the first time in the Newcastle measures.

A recent examination of the stratigraphical position of the Belmont insect beds has led the writer to the conclusion that the position given to them by Dr. Tillyard (Proc. Linn. Soc. N.S.W., xlii, Pt. 4, 1917) from information supplied to him by the writer, is much too low, and for that the writer is entirely to blame. At the present time the Broken Hill Proprietary Coy. is opening up a coal mine within a few hundred yards of these Belmont fossil insect beds; and the shafts being sunk in connection with this mine afford reliable data on which the stratigraphical position of these beds may be determined fairly accurately. These particulars have been generously supplied to the writer by J. Jeffries, Esq., Superintendent of that Company's coal mines, and by J. Fallins, Esq., manager. The stratigraphical position of these fossil insect beds is one hundred and eighty feet above the seam of coal known as the Australasian seam; and eighty feet above the coal seam outcropping at sea level at the South Head of Lake Macquarie entrance; they lie between the Pilot Seam below, and the Great Northern Seam above. This position places them some four hundred feet higher in the series than they were formerly placed, but still well within the Permian System.

My sincere thanks are tendered to W. C. Davies, Esq., Photographer, of the Cawthron Institute, Nelson, New Zealand, for the excellent photographs which illustrate this paper, as well as to Dr. R. J. Tillyard, F.R.S., who was instrumental in obtaining Mr. Davies's services; also to Mr. W. S. Dun, Palaeontologist, Dept. of Mines, Sydney, for help freely given to the writer while engaged on the present paper; and for the same reason they are extended to Dr. A. B. Walkom.

Family Limnadidae.

Genus Leaia.

Leaia mitchelli, Eth., Jr. Pl. xli, figs 1 and 2; Pl. xliii, fig. 19.

Proc. Linn. Soc. N.S.W., (2) vii, 1892.

Outline of valves suboval or subsemicircular, dorsal line straight, other margins rounded; each valve bears the two radials typical of the genus dividing it into three unequal areas, of which the anterior one is the smallest and nearly semicircular, the middle area is the largest, and it and the posterior one are triangular, the radials originate at the umbo in close proximity, the anterior one is gently curved and almost vertically directed to the ventral margin; the posterior radial is straight, except for a gentle curve near its origin, and reaches the ventro-posterior margins at their junction, forming an angle with the dorsal line of approximately 45°; the concentric growth lines number from eight to fourteen according to age and size, the latter being the maximum; they are fairly regularly spaced, very gently curved on the posterior and medial areas, but strongly so on the anterior lobe; these striae, as they cross the radials, produce a frill-like pattern. The late R. Etheridge, Junr., refers to an emargination of the posterior margin in his description of the species which I have not been able to recognize.

The grounds on which specific rank was conferred upon this *Leaia* were fully explained in the original description. It may further be pointed out that, in Mr. Etheridge's description of the species, the umbones are said to be sharp; but in no case among the many hundreds of specimens that have come under my notice, has such an umbo been observed; in most cases the umbones are indistinctly indicated and not prominent.

The following are the dimensions (length and width) in millimetres of a few more or less mature individuals: 7.8, 5.5; 7.8, 4.7; 6.25, 4.7 (3 examples). These dimensions are fairly constant as far as relative length to width is concerned. The figures given of the specimens from which the original description was made are only crude sketches, partly owing to the imperfection of the specimens which were then available.

Leaia intermediata, n. sp. Pl. xli, figs. 3 and 4.

Outline of valves scaphoidal or subsemicircular; each valve bears two prominent hollow radials which reach to the edge of the borders and a third short one posterior to the two principal ones, the anterior one very slightly curved and inclined posteriorly, the middle one straight, except for a short sharp curve near its origin, obliquely directed towards the posterior latero-ventral margin at an angle of about 30°; the posterior rib reaches less than half the distance across the valve, dorsal line straight, the other margins distinctly rounded, and have thin edges; concentric growth lines about twelve in number and evenly spaced, and in passing over the anterior and posterior radials form on them a frill-like pattern. In outline and most other respects this form resembles *L. mitchelli* and, but for its third rib, might be placed with that species. From *L. kleiveriana* it differs by having the short rib posteriorly instead of intermediately placed. From other tricarinate types it is separated by the shortness of its third rib.

Dimensions: Length 10.0 mm., width 7.5 mm. (the largest specimen known); the type (Pl. xli, fig. 3) is 7.0 mm. long and 5.0 mm. wide.

LEAIA OBLONGA, n. sp. Pl. xli, fig. 5; Pl. xliii, fig. 18.

Outline subtrapezoidal or suboblong; anterior end strongly rounded, posterior one very slightly so, ventral margin nearly straight and parallel with the dorsal line; the lateral radials originate in the same point at the umbo, the anterior one is mildly curved, directed towards the ventral margin with a very gentle posterior inclination, the posterior one straight but for a slight curve at the umbo and makes with the dorsal line an angle of about 30°; concentric striae thirteen in number, perhaps fourteen, mildly curved, and regularly spaced, posterior area much larger than either of the other two; umbo mildly tumid. Dimensions: Length 11.0 mm., width 3.9 mm. approx.

This is a rare form and has up to the present been found only in the Belmont beds. Its distinguishing features are (1) great proportionate length to width, (2) trapezoidal or oblong shape, (3) large size of the posterior area.

LEAIA DISCOIDEA, n. sp. Pl. xli, fig. 6; Pl. xliii, fig. 22.

Shape discoidal; each valve bears the two radials typical of members of the genus *Leaia*, originating at the umbo rather far apart, anterior one gently curved and terminating much short of ventral margin, the other straight; posterior area segmental in shape, less than a semicircle, smaller than either of the other two, the medial one being the largest; the concentric growth lines are too faint to be recognized; umbo indistinct and less anterior than in other species of the genus; the length and width are about equal.

On first acquaintance with this odd form of *Leaia* it appeared to the writer likely to be merely an abnormal specimen of one or other of the more common types associated with it, but, as several specimens having identical characters have been obtained, this idea has been relinquished for the acceptance of it as a new species. The features on which its specific rank is based are: (1) Its discoidal outline, (2) small posterior area, (3) comparatively short anterior carina. *Loc.*—Chert quarries, near Belmont.

LEAIA QUADRIRADIATA, n. sp. Pl. xli, fig. 7.

Contour of the valves much the same as those of *L. mitchelli*; differs from that species chiefly in the following points: Two extra weak and short radials on each valve, the one anterior and quite close to margin, the other posterior and close to the dorsal margin; the latter is more distinct than the former, and traverses and extends along the valve for about two-thirds of the distance between its origin and the posterior margin; the anterior one is much shorter; the two strong radials, typical of the genus, increase in stoutness for about two-thirds of their length and then gradually obsolesce, and do not reach the margin; the greater number of concentric striae (apparently sixteen or more) on its valves. The distinguishing feature of the species is its possession of four radials. In contour it resembles also *L. intermediata* (mihi).

Dimensions: Length 4.0 mm., width or height 3.0 mm. These dimensions, though less than the average for most of the local forms, are greater than those given for either *L. leidyi*, *L. leidyi* var. *williamsoniana*, or *L. leidyi* var. *salteriana*.

Leaia paraleidyi, n. sp. Pl. xli, fig. 8.

Left valve subquadrate, flat, dorsal margin straight, anterior subtriangular, posterior one mildly rounded, as is also the ventral one, umbo quite anterior and under it, anteriorly, there is a slight emargination; the radials originate in a point at the umbo, are stout, of uniform dimensions throughout, imbricated by the concentric striae, the posterior one is straight and makes an angle of 30° with the dorsal margin, anterior one very gently curved, and meets the anteroventral margin slightly posterior of the vertical from its point of origin; concentric striae are nine to ten in number, distinct, regularly spaced, and fairly uniformly increasing their distance apart as they recede from the umbo; all are curved, those on the anterior area strongly, but those on the posterior and medial areas mildly, so. Dimensions: Length 8.0 mm., width 6.0 mm.

This *Leaia* so closely resembles *L. leidyi* that it is with hesitation I separate it from that species. The points of difference relied upon for the separation are (1) the local form is much the larger, and differs materially in its proportion of length to width (height), 4: 3, as against 5: 3, or 12: 7 for *L. leidyi*, (2) the emargination of the anterior border just under the umbo, (3) the rounded margins of the local form, (4) its curved anterior carina, and (5) the triangular shape of the anterior area or lobe of the local form as against a semicircular one in the other. The species now being dealt with, and *L. leidyi*, var. *williamsoniana* Jones, also are much alike, but the latter is much the smaller, and its posterior carina makes with the dorsal margin an angle of 45° while in the former this angle is 30°. The difference in these two angles seems to me to have much significance. In comparing and contrasting the present species with *L. mitchelli*, one is confronted at once with a great difficulty in the incomplete and more or less inaccurate figures which accompany the description of that species. The only feature of the valves which they give that can be relied upon is their outline. The outline of the present species is more nearly oblong than is *L. mitchelli*, and all the margins, except the dorsal one which is straight, of the latter species, are more uniformly rounded than is the case with the similar margins of the former; in the latter, too, the concentric striae are more numerous than they are in the former, and the latter is the more elongate of the two; the subtriangular shape of the anterior lobe of the former, as against the semicircular form of that of the latter, helps to distinguish the one from the other; the proportion of length to width in the latter is 3: 2, and in the former 4: 3, approximately in each case.

Loc.—Chert quarries, near Belmont, Lake Macquarie, Parish of Kahibah, County Northumberland.

Horizon.—A short distance above the old Cardiff Coal Seam worked on the north-western shore of Belmont Bay (Great Northern Seam of David).

LEAIA PINCOMBEI, n. sp. Pl. xlii, fig. 9.

Outline of valves subscaphoidal, mildly oblique, bicarinate, carinae originate rather widely apart, very gradually increase in cross section as they recede from the umbo; concentric striae twenty at least; their distance apart gradually increases as they recede from the umbo until the borders are approached, when they become more compacted; the anterior lobe is subelliptic, relatively small; dorsal margin mildly sinuate, hollow and prominent; anterior and ventral margins rounded, posterior one subtruncate. The posterior radial meets the dorsal margin at an angle of 30° and is nearly straight; the anterior one meets the same margin at an angle of 75° and is also practically straight.

Dimensions: Length 7.0 mm., width 5.0 mm.

The distinguishing features of this species are (1) the numerous concentric striae, (2) smallness of the anterior lobe, (3) straightness of the anterior carina, (4) mild sinuosity of the dorsal margin, and (5) obliquity of the valves.

Same locality as the preceding species.

Dedicated to Mr. T. H. Pincombe, B.A., headmaster of the Public School, Wallsend.

LEAIA ELLIPTICA, n. sp. Pl. xlii, fig. 10.

Outline of valves subelliptic, bicarinate; carinae originate rather widely apart, prominent, of equal cross section throughout their length; the posterior one makes with the dorsal margin an angle of 30°; both are practically straight and barely reach the ventral margin; of the three parts into which the shell is divided by the carinae, the anterior one is semicircular and the smallest, the middle one relatively large and posterior one relatively small; dorsal margin straight, ventral margin almost so, anterior one forms the arc of a semicircular anterior division; posterior margin very strongly rounded and protrusive; umbo indistinct; concentric striae about sixteen in number, distinct; as they cross the anterior and posterior divisions they are decidedly curved, but only very slightly so on the middle division, very evenly spaced.

Dimensions: Length 5.7 mm., height 3.2 mm., ratio 7: 4 nearly.

This variety belongs to the *L. mitchelli* type, from which it differs in having a greater proportionate length to width, more decidedly rounded and protrusive posterior margin, straighter ventral margin, relatively smaller posterior division, and apparently relatively larger anterior division; also radials more slender and of even cross section throughout their length, and in the slight obliquity of its valves.

Same locality as the preceding.

LEAIA OVATA, n. sp. Pl. xlii, fig. 12.

Outline scaphoidal, much longer than wide, anterior and posterior margins distinctly rounded, ventral subparallel to the dorsal one, which is straight, two typical radials present, dividing the surfaces of the valves into three unequal parts or lobes; these radials reach, or nearly so, the ventral margin, are of uniform section throughout, anterior one gently curved and reaches the junction of the antero-ventral margins, posterior of a vertical drawn from its point of origin; the posterior radial is straight, except for a distinct, short curve near its point of origin; the concentric growth lines are fourteen in number, evenly spaced, strongly curved on the anterior lobe, nearly straight on the medial lobe and distinctly curved on the posterior lobe; posterior to the principal pair of radials is a very short one which, viewed from the inside of a valve, much resembles a socket for a hinge tooth; it is so short that to consider it a radial seems quite inadvisable; umbo pointed; dorso-posterior lateral angle, decidedly rounded.

Dimensions: Length 5 mm., width 3 mm.

This form is so closely related to *L. mitchelli* that it is with much hesitation I decide on its separation from that species; the reasons for doing so are (1) the concentric striae are more numerous on its valves than are found on the valves of any specimens of *L. mitchelli* of an equal size, (2) the greater disparity between its proportional length and width (5: 3) as compared with 3: 2 for the other, (3) the even sectional diameter of its radials throughout their length as against a gradual thickening of these parts in *L. mitchelli* as they recede from the umbo. The differences between these two forms enumerated above are admittedly not great; but, when it is recognized that in this genus there are only a small number of superficial features, on which their classification has to be worked out, there appears some necessity to take into account even slight variations of these parts which may be observed in the different individuals.

Loc.—Near Belmont.

Horizon.—Not much above the coal seam, outcropping nearly at sea level on the north shore of Belmont Bay.

LEAIA LATISSIMA, n. sp. Pl. xlii, fig. 11.

It is not necessary to describe this in detail, as a glance at the figure will at once reveal its characteristic features. Its valves are subquadrate; the radials do not reach the margins, the anterior one is mildly curved, increases in size as it recedes from the umbo; the posterior one is straight, of uniform size throughout, and meets the dorsal border at an angle of about 40°; all the margins, except the dorsal, which is straight, are distinctly rounded, concentric striae apparently eleven in number, widely spaced, distinctly curved, indistinct on the posterior lobe, lateral and ventral borders wide.

Dimensions: Length 8.8 mm., width 6.7 mm., ratio 4: 3.

The size of this species is greater than the ordinary for most *Leaia*, and the linear character of the posterior carina is rather unusual.

Same locality and horizon as the preceding.

LEAIA COMPTA, n. sp. Pl. xlii, fig. 14.

Outline subscaphoidal, dorsal margin straight, slightly oblique between the dorso-lateral angle (posterior) and the umbo, thickened, nodulated; anterior margin semicircular, posterior margin very mildly curved, and the ventral one distinctly so; the two typical carinae are present on each valve, are fairly strong, of even dimensions throughout their whole length, hardly reach to the edge of ventral margin, both gently curved at the umbo; for the rest of its course the posterior is straight, and the same may be said of the anterior one, which terminates very slightly anteriorly of its point of origin; anterior lobe semicircular, and, as is the rule, the other two are triangular, the middle one being the larger; concentric striae twelve, perhaps fourteen, in number and truly concentric with the respective margins; the umbo prominent and tumid.

Dimensions: Length 7.83 mm., width 5.50 mm. (the type specimen).

This is a beautiful and symmetrical *Leaia*, and embodies in itself most of the features generally found in members of the group, and, perhaps, might have ranked simply as a variety of one or other of the forms dealt with in the present paper, for instance, of *L. mitchelli* Eth.; but after careful consideration of its features, specific rank has been proposed for it. From all other local forms it differs in being much more inflated or convex, and in having a more prominent umbo; from the *L. leidyi* types it is separated by the absence of parallelism of the dorsal and ventral margins and the more decided curving of its concentric striae, and also in the possession of a larger number of these latter than most other forms, as well as in its greater size. From *L. mitchelli* it differs in the greater convexity of its valves, more prominent umbo, its carinae being of uniform size throughout their length and not reaching quite to the ventro-lateral margins, in having a semicircular and larger anterior lobe; the ratio between the respective lengths and widths is nearly the same, and in full-grown individuals of each type dimensionally and in the number of their concentric striae they are practically identical.

The type specimen of this species was obtained from a horizon about four hundred feet below the Belmont chert beds, and therefore from a horizon much older than the latter beds.

Loc.—Merewether Beach and Croudace's Hill, Lambton, Parish of Newcastle, County Northumberland.

Horizon.—The Dirty Coal Seam, Newcastle Coal Measures, associated with the characteristic fossil flora of these measures.

LEAIA BELMONTENSIS, n. sp. Pl. xlii, fig. 15.

Outline scaphoid or subsemicircular, dorsal margin straight, mildly thickened and nodulated, ventral and lateral margins rounded, each valve bears three radials or carinae, the posterior one being the strongest but not seeming to reach the dorsal margin; the three originate in a point under the umbo; except for a slight arching near the point of origin the posterior and middle radials are straight, the anterior one very gently curved and reaches the antero-ventral margin decidedly in advance of its point of origin; it is needless to particularize the four areas into which the surface of each valve is divided by the three radials, for the figures of the plates clearly show the characters of these. The concentric growth lines number some fourteen, and on all the areas except the anterior one are very mildly curved, those on the latter surface being strongly curved; as these striae cross the radials they effect a frilling design, more or less distinct; on the posterior and anterior areas the striae are quite regularly spaced, but on the other areas their distance apart gradually increases as they recede from the umbo.

Dimensions.—Length 7.0 mm., width 4.7 mm.

Several tricarinate species of *Leaia* have been described from Europe and North America, and among our forms there are several, whose valves are more or less tricarinate; but the only species I know on which the carinae cross the surface of the valves from umbo to the opposite margins is *L. carinata* Meek and Worthen (*Illinois Geol. Surv. Rep.*, iii, 1868, p. 541) but in that species the third carina is close to and nearly parallel with the dorsal margin. In the local type the third carina is well apart from the dorsal margin and forms with that margin and the posterior margin a subisosceles triangle, and because of this difference our form is separated from the North American species.

Loc.—Chert quarries, near Belmont.

LEAIA COLLINSI, n. sp. Pl. xliii, fig. 16.

Outline subsemicircular, bicarinate, carinae originate completely anteriorly at the umbo in the same point. The photo. of a specimen of the species (Pl. xliii, fig. 16) shows its superficial features so clearly that it is unnecessary to point them out here. The reasons for giving specific rank to this form are (1) the very anterior position of umbo, (2) the distinct curvature of the radials and of the dorsal margin as they recede from their point of origin at the point of the beak, (3) the strongly increasing diameter of the hollow dorsal margin as it recedes from its point of origin (the width of the dorsal margin of this species in this particular is singular), (4) the small number and widely spaced concentric striae, (5) relatively small anterior area, (6) subequality in area of the posterior and middle divisions. These enumerated features are the grounds on which the merit for specific rank of this form are based. Dedicated to my friend, Mr. V. B. Collins, Lecturer in Coal Mining and Mine Surveying, Newcastle Technical College and School of Mines.

Same locality and horizon as the preceding.

LEAIA QUADRATA, n. sp. Pl. xliii, fig. 17.

Outline subquadrate, depth or width apparently nearly equal, bicarinate, carinae originate subcentrally, only moderately so, anterior one distinctly curved and reaches the ventral margin, posterior one straight; concentric striae very numerous (probably twenty), closely spaced adjacent to the ventral margin; dorsal and anterior margins straight, posterior and ventral rounded.

Although the only specimen of this form available, it exhibits features decidedly different from other species known to the writer.

Same locality and horizon as the preceding.

LEAIA SP. INDET. Pl. xliii, fig. 20.

Only a single specimen of this *Leaia* is known. It is of large size, its length being 8.1 mm., and width 5.5 mm., ratio of length to width being approximately 10: 7; its carinae do not reach to the ventral margin, the concentric striae seem to be widely spaced and the outline is suboval; but the features are too indistinct for determination.

Same locality as the preceding.

LEAIA SP. INDET. Pl. xliii, fig. 21.

Outline suboblong, tricarinate, with a fourth ridge running crosswise on the third (probably accidental); anterior and posterior radials straight; concentric striae faint, but appear to be numerous; dorsal margin straight and stout, ventral one mildly curved, anterior and posterior margins distinctly curved. This form differs in several features from *L. intermediata*, for instance, in its more oblong shape, longer third carina, less concentric striae and strong dorsal margin.

EXPLANATION OF PLATES XLI-XLIII.

Plate xli.

1, 2.—Left and right valves of *Leaia mitchelli* R. Eth., Junr.

3, 4.—Two left valves of *Leaia intermediata* Mitchell. Fig. 3, × 4; Fig. 4, × 6.

5.—*Leaia oblonga* Mitchell. A right valve of a large specimen posteriorly incomplete; features faintly preserved.

6.—*Leaia discoidea* Mitchell. A nearly complete right valve.

7.—*Leaia quadricarinata* Mitchell. A right valve and a left valve of medium size, perfect in outline, and the features well shown.

8.—*Leaia paraleidyi*. A well preserved left valve.

Plate xlii.

9.—*Leaia pincombei* Mitchell. A good specimen.
10.—*Leaia elliptica* Mitchell. A well preserved left valve.
11.—*Leaia latissima.* A large and perfect left valve.
12.—*Leaia ovata* Mitchell. Inside view of a left valve. × 6.
13.—*Leaia* sp. indet. An incomplete specimen of what seems to be a monocarinate species.
14.—*Leaia compta* Mitchell. A left valve.
15.—*Leaia belmontensis* Mitchell. An almost perfect right valve.

Plate xliii.

16.—*Leaia collinsi* Mitchell. A splendid right valve.
17.—*Leaia quadrata* Mitchell. An imperfect specimen yet showing the characteristic features of the species.
18.—*Leaia oblonga* Mitchell. A counterpart of a left valve of medium size.
19.—*Leaia mitchelli* (?) Eth., Junr. A beautiful and large specimen of this species.
20.—*Leaia* sp. indet. Features faintly preserved.
21.—*Leaia* sp. indet. A right valve of a tricarinate species near *L. intermediata*; but may prove to be new.
22.—*Leaia discoidea* Mitchell. A left valve perfect in outline but otherwise indistinct. × 6 about.

All the figures of the above plates, where not otherwise indicated, are multiplied ten times.
